CLAIMS

1. A method for determining an optimal focus distance of a molecular scanner, the method comprising:

scanning portions of a reference array over a range of positions, each position representing a different distance between an illuminated region of the reference array and an emitted-light detection component of the molecular array, each portion scanned at a different position;

assembling data collected from scanning the reference array into a representation of an intensity/position function; and

employing a focus-distance determination method to determine an optimal focus distance or range of focus distances.

2. The method of claim 1 wherein scanning portions of a reference array over a range of positions relative to an emitted-light detection component further includes:

for each position,

scanning a set of rows,

filtering the intensity values scanned for each row, and

averaging the intensity values for the set of rows into an average intensity value for the position.

3. The method of claim 1 wherein assembling data collected from scanning the reference array into a representation of an intensity/position function further includes associating each position with an average intensity value.

4. The method of claim 1 wherein employing a focus-distance determination method to determine an optimal focus distance or range of focus distances further includes employing a peak-intensity-focus-distance determination method.

5. The method of claim 4 wherein the peak-intensity-focus-distance determination method comprises:

using an intensity/position function for each channel of the molecular array scanner,

determining the position of the peak intensity in the intensity/position function, and

starting from the peak-intensity position, moving right and left in position in order to identify a left plateau position and a right plateau position at which the corresponding intensity falls below a threshold value, and selecting the positions between the left plateau position and the right plateau position as the plateau interval for the channel;

determining an overlap position interval corresponding to the overlap in position of the plateau intervals of each channel; and

when the overlap position interval and plateau for each channel meet acceptance criteria, returning a position within a plateau interval as the focus distance.

6. The method of claim 5 wherein the acceptance criteria comprise the overlap position interval having a size greater than an overlap position interval threshold size and the plateau for each channel having a size greater than a plateau threshold size.

7. The method of claim 1 wherein employing a focus-distance determination method to determine an optimal focus distance or range of focus distances further includes employing a window-focus-distance determination method.

8. The method of claim 7 wherein the focus-distance determination method comprises:

using an intensity/position function for each channel of the molecular array scanner,

determining the position of the peak intensity in the intensity/position function for each channel, and

returning an error when the positions of peak intensity for each channel do not all fall within a central portion of the range of position;

finding, for each channel, a plateau interval in the intensity/position function for the channel;

finding an overlap position interval that represents overlap in positions from the plateau intervals for each channel;

when the overlap position interval meets a set of acceptance criteria,

finding a focus-distance within the overlap position interval.

9. The method of claim 8 wherein finding, for each channel, a plateau interval in the intensity/position function for the channel further includes:

for decreasing window intervals sizes,

searching window intervals in the position range of the intensity/position function for the channel for a window interval in which intensities differ by less than a threshold value,

when a single window interval contains intensities that differ by less than the threshold value, returning the single window interval,

when more than one window interval contains intensities that differ by less than a threshold value, selecting a window interval having the least difference in intensities and returning the selected window interval, and

when the current window interval size is less than a minimum window interval size, returning a default window interval.

10. The method of claim 9 wherein finding a focus-distance within the overlap position interval further includes:

starting from a center position within the overlap position interval, searching outward from the center position to find a small window interval closest to the center position with intensity differences less than a small-window-final-intensity-difference threshold.

11. Signal intensity data scanned from the surface of a molecular array at a focus distance determined by the method of claim 1 encoded by:

storing representations of the signal intensity data in a machine readable medium;

transmitting representations of the signal intensity data over an electronic communications medium;

displaying the signal intensity data on display device; and

printing representations of the signal intensity data in a human readable medium.

12. A set of computer instructions for carrying out the method of claim 1 encoded by one of:

storing the computer instructions in a machine readable medium;

transmitting the computer instructions over an electronic communications medium; and

printing the computer instructions in a human readable medium.

13. A molecular array scanner comprising:

a probe-molecule excitation system;

an emitted-light photodetection system that produces a signal representative of the emitted-light intensity;

a molecular-array-holding stage that holds a molecular array for scanning and that can be moved through a range of positions that place an illuminated region of the surface of the molecular array at different distances from the emitted-light photodetection system; and

an automated focus-distance-determination subsystem.

14. The molecular array scanner of claim 13 wherein the automated focus-distance-determination subsystem:

scans portions of a reference array over a range of positions, each position representing a different distance between an illuminated region of the reference array and the emitted-light photodetection system, each portion scanned at a different position;

assembles data collected from scanning the reference array into a representation of an intensity/position function; and

employs a focus-distance determination method to determine an optimal focus distance or range of focus distances.

15. The molecular array scanner of claim 14 wherein the automated focus-distance-determination subsystem scans portions of a reference array over a range of positions by:

for each position,

scanning a set of rows,

filtering the intensity values scanned for each row, and

averaging the intensity values for the set of rows into an average intensity value for the position.

16. The molecular array scanner of claim 15 wherein the automated focus-distance-determination subsystem assembles data collected from scanning the reference array into a representation of an intensity/position function by associating each position with an average intensity value.

17. The molecular array scanner of claim 15 wherein the automated focus-distance-determination subsystem employs a focus-distance determination method to determine an optimal focus distance or range of focus distances by employing a peak-intensity-focus-distance determination method.

18. The molecular array scanner of claim 15 wherein the automated focus-distance-determination subsystem employs a focus-distance determination method to determine an optimal focus distance or range of focus distances by employing a window-focus-distance determination method.

19. Signal intensity data scanned from the surface of a molecular array at a focus distance determined by the molecular array scanner of claim 13 encoded by:

storing representations of the signal intensity data in a machine readable medium;

transmitting representations of the signal intensity data over an electronic communications medium;

displaying the signal intensity data on display device; and

printing representations of the signal intensity data in a human readable medium.

20. A set of computer instructions that implement the molecular-array-scanner automated focus-distance-determination subsystem of claim 1 encoded by one of:

storing the computer instructions in a machine readable medium;

transmitting the computer instructions over an electronic communications medium; and

printing the computer instructions in a human readable medium.